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NEXT GENERATION OF LIFE SCIENCE HARDWARE FOR SPACE RESEARCH

Abstract

The future of human exploration in space strongly relays on the understanding of the effects of the space environment on biological systems, and among others, on the human body and on the interactions between microorganisms with solid surfaces. With these aims, a wide range of experiments are performed on board the International Space Station (ISS) using small autonomous or semi-autonomous bioreactors supporting different models under investigation. Kayser Italia develops space hardware systems and provides mission support for investigations on biological systems in space. In particular, several types of bioreactors (experimental units or EU), have been developed. EUs reduce a laboratory into a hand-sized device dedicated to life science research experiments on space platforms, such as ISS. They allow the autonomous execution of a scientific protocol, being designed to contain the cell culture and all the chemicals (culture medium, wash buffers, fixatives, etc) required by the experiment. To maintain a desired temperature during the experiment execution an incubator, such as the Kubik (ESA), is employed. The experiment is autonomously performed and controlled by a timeline on the microcontroller, housekeeping data are recorded during the mission and downloaded at re-entry. Up to now, investigations have been performed on a variety of biological models: human and animal cells, tissues, yeast, algae, small animals and plants. Kayser Italia is developing a new fleet of bioreactors for the next ESA space biology experiments, to be integrated in the Kubik incubator of ESA on board ISS: • Nano Antioxidant (Nanotechnological countermeasures against Oxidative stress in muscle cells Exposed to Microgravity, PI G.Ciofani IIT Pontedera, Italy) • Molecular Muscle (Establishing Molecular Mechanisms of and Countermeasures to Muscle Decline in Space, PI T. Etheridge U. Exeter, UK and N. Szewczyk U. Nottingham, UK) • BIOROCK (Extraterrestrial Geomicrobiological Package Test Bed for the ISS, PI K.W. Finster, U. Aarhus, Danmark and C. Cockell U.Edinburgh, UK) At a later stage: • BIOFILMS (Testing antimicrobial metal surfaces under spaceflight conditions an effective strategy to prevent microbial biofilm formation; PI R. Moeller, DLR, Germany) • ROTIFER-B (Studing the effect of space flight on bdelloids; PI K. Van Doninck, U. Namur, Belgium) • OSTEO (Characterization of the gravity-responsive osteogenic cells; PI G. Carmeliet Catholic Univ. Leuven, Belgium) The recently developed hardware will pave the way to new investigations and will address key scientific questions in the various fields of space research such as basic biological research or interaction of bacteria with surfaces.